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A Fuzzy Inference System in Constructional Engineering Projects to Evaluate the Design Codes for RC Buildings

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Abstract

Economical design of a building is one of the main aims that should be followed because of its importance in constructional projects. In order to have an economical design, longitudinal reinforcing bars in the reinforced concrete members are among those parts of the structure that can be designed economically. The application of fuzzy inference systems provides an effective tools to handle the uncertainties and subjectivities arising in the designing process of buildings. Therefore, the main purpose of this paper is to propose a fuzzy inference system to evaluate the building design codes from an economical point of view. For this purpose, after designing the mentioned fuzzy inference system, three examples of three-dimensional concrete buildings are analysed and designed using different codes. For all these codes, the structural properties of concrete buildings, the gravity and the seismic loads are considered to be the same. Finally, it finds that the fuzzy logic theory is an effective and practical tool to compute a value that shows the distance between the designed building and the economically designed building. Also, it concludes that between the studied codes, (EUROCODE 2-1992, Hong Kong CP-04, CSA A23.3-04 and ACI 318-05), the ACI 318-05 and Hong Kong CP04 codes lead to a more economical design for taller buildings. For low-rise buildings, the CSA A23.3-04 and ACI 318-05 codes lead to an economical design. Also, the EUROCODE 2-1992 has a minimum value for the economical design of all the considered buildings.

Keywords: Fuzzy Logic Theory; Economical Design; Seismic Load; Concrete Building; Design Codes.

1. Introduction

In concrete members, longitudinal reinforcing bars are utilized in order to increase low tensile strength. In designing concrete sections, the criterion for selecting standard reinforcing bars is the value of stress which is applied on that section. Therefore, in reinforced concrete beams and columns, due to the weakness of the concrete against the tensile stress, steel bars are placed in tensile zone. In addition, in reinforced concrete members, stretching due to bending is sustained by longitudinal reinforcing bars and pressure due to bending is sustained by the concrete in the compression zone [1-5]. Finding optimum values of steel bars for the concrete sections is effective in such a way that, in addition to sustaining the internal forces induced by the external forces, the project would become more economic.

Nowadays, the principal objectives of structural designing have been used to design a structure for stability, strength and serviceability, while considering it to be both economic and aesthetic. [6]. The stability needs to be considered so as to prevent overturning, sliding or buckling of the structure, or parts of it, under the action of loads (the gravity loads, seismic load, etc.). The strength needs to be taken into account to safely resist the stresses induced by the loads in various structural members and the serviceability is required to be considered to ensure satisfactory performance under service load conditions –implying provision of adequate stiffness and reinforcements to contain deflections, crack-widths and vibrations within acceptable limits, and also providing impermeability, durability (including corrosion-resistance), etc.

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